

## THE CAUSE OF TREMBLES IN CATTLE, SHEEP AND HORSES AND OF MILK-SICKNESS IN PEOPLE.

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(Continued from p. 470.)

No. 4. A tom-cat weighing 5 lbs., 10 ounces. Had been liable to fits of coughing and vomiting, when fed meat. He made a poor subject. I gave him milk in which stems without leaves had been soaked, and after two days milk in which leaves had been soaked. He soon contracted diarrhoea which probably prevented much of the poison being absorbed into the blood. After four days he would not take any more poisoned milk. He was watched a good deal but was seen to tremble only a few times and then under conditions which might possibly have produced trembling without the aid of any poison. However, single tremors were noticed a number of times, two or three times a paw or foot when raised or stretched out by himself was seen to tremble. Occasionally the head trembled a little. A slight trembling of the ears and tail continued for a considerable time and most persistent of all a motion of the loins. This is the part in which trembling is said to be most noticeable in cattle. Respirations at one time 35 per minute.

When he would take no more poisoned milk I gave him a leg of rabbit No. 6. The next day while he was drinking cold milk I noticed strong trembling. Earlier in the day he had eaten greedily another leg and side of the rabbit. The next day, when held up by the nape his hind legs trembled and when put down he trembled all over. The meat seemed to affect him more than the milk. He ate readily all that was given and if I had had enough of it, would probably have been killed by it. As it was, he shared the fate of No. 2 and post-mortem examination at the same time showed nothing more.

### *Dog.*

No. 5. A small cur, was given, Nov. 25, at 8:15 A. M., milk mixed with a water extract of snake-root and at 11:45 the leaves and tops of several herbs broken up and mixed with hash, also a chicken's liver dipped in the extract. No effect was noticed that day but at 3:30 the next morning Mr. Reinheimer says the dog shook hard all over so that he thought it was dying. At 10:10 A. M., as it lay on its side in the sun, it stretched out its legs as if yawning and trembled in a very unnatural manner. After dinner also we noticed some trembling of the legs especially when he changed his position. He showed some weakness, dullness and less disposition to bark than usual at sounds. Nevertheless, he was not so different from usual except in the

early morning but what all these things might have escaped notice if he had not been watched. He was dull enough at any time.

Nov. 27, he seemed natural. At 9:30 P. M. he was given six tablespoonfuls of strong extract. All next morning he "lay extended on the floor, seemed indisposed and ate very little. At 6:30 P. M. he ate a little of the snake-root mixed with potato. Nov. 29, rather lively, if anything, actions all natural." After this he showed little, if any, effect of the poison.

#### *Boy.*

"On Monday evening at 9:30 P. M. while I held the dog's mouth open a friend poured the extract into the dog's mouth. The dog choked and coughed the extract into my face and mouth. I was in the room while the mixtrue was steeping and also on the previous evening. At 10:30 I was taken with a fit of cramps and the following day was nauseous. Several times during the three following days I had fits of trembling, always accompanying the extension of limb."

—BARTELLE H. REINHEIMER.

While another of my pupils was preparing a decoction of snake-root, although it did not affect him, yet on his mother, who was not well, it had a sickening effect, though she was not in the same room.

#### *Rabbits.*

No. 6. A rabbit, weighing about  $1\frac{1}{2}$  lbs. Alton Fuchs began feeding snake-root Dec. 9, 9 A. M. It was kept supplied most of the time and given nothing else except on one occasion, a few lettuce leaves. On the afternoon of Dec. 12 I was surprised on looking in its box to see the rabbit dead for we had seen no trembling nor anything the matter with it. Probably if we had watched it that day we would have seen it tremble.

From our experience with Cat No. 2 we had expected to see the legs tremble when unsupported, but later experience with rabbits showed that they are not affected in this way. This rabbit had taken altogether about 2 ounces of snake-root, mostly leaves and branches, likely much more than necessary to kill it. The stomach and large intestine were found well filled. No inflammation or congestion.

No. 7. The mate to No. 6, was fed by Oscar Kubach, the first snake-root being given in the morning of Dec. 13. He noticed some trembling in the evening and more the next evening. On Dec. 16 it was more pronounced. The rabbit died that afternoon between 1 and 3, the interval from the first feeding being about the same as in the case of No. 6. It took both

water and milk; these were not offered to No. 6. It had eaten leaves and branches of about 35 plants. No inflammation was found.

No. 8. A female rabbit, weight after death 1383 grams. With aseptic precautions A. E. Guenther, Ph. D., Professor of Physiology in the University of Nebraska, injected under the skin of her back about  $1\frac{1}{4}$  cubic centimeters of an extract of snake-root made by boiling five ounces of the plants in two quarts of water until the liquid was reduced to about two ounces, after several days kept at boiling temperature again for an hour and heated to boiling a third time just before using. I was not looking for immediate results but three minutes after the injection was made, while I was still holding her on my knee I could feel her tremble and in a minute more we could see trembling of the loins very plainly. Half an hour later she showed less decided trembling, breathing rapid and deeper than before the injection, at times a twitching of loins or sides repeated not rapidly enough to call trembling but quite unnatural; also a vibration of the flesh over the angle of the lower jaw, the last, perhaps, not caused by the poison. She moved about freely and ate lettuce and cabbage. The visible effects of the poison lessened through the day and the following day seemed entirely gone, except the temperature, which gradually approached the normal. The injection was made at 12:15 P. M., Dec. 31. 11:30 A. M.—temperature 104.8°; 1:30 P. M.—104.2°; 3:30 P. M.—105.1°; 5:30 P. M.—106.°; 7:30 P. M.—105.8°; 9:30 P. M.—106.°. Although taken fourteen times between the afternoon of Dec. 29th and the time of injection it was in no instance above 104.8°. Forty-eight hours after the injection the temperature had become normal.

Jan. 3, 7:50 A. M., I began feeding her white snake-root of which she took the leaves and branches readily. I kept her pretty well supplied each day with snake-root, giving also some good food. The effects on her actions and appearance were not striking and might have escaped notice if I had not looked for them. Deep breathing, sometimes rapid, especially noticeable in the loins, with some diminution of strength were noticed. She would move about without urging but less rapidly than a normal rabbit. Her temperature taken several times each day showed no marked influence of the poison. On the whole it was below normal, exceeding 103.8° only on the day she began to eat the weed, i. e., before it was digested, and about 23 hours before she died, when it was 104.3°. Jan. 7, her appetite was not so good and her eyes dull. In the evening deep breathing was noticeable and trembling resembling shivering. Next morning I found her lying on her side, as if dead. When laid on top of box she gasped for breath, not violently but with increasing

energy, so I thought she might revive. At the last were a few kicks. Half an hour after she had expired an auricle was still beating. The stomach, caecum and colon were filled with partly digested snake-root. Bladder filled, although she had drunk no water or milk for several days. Viscera appeared natural. We were not sure whether the veins were a little engorged. There had been no constipation of any consequence. Total amount of snake-root consumed was between two and three ounces. Death occurred 120 hours after first feeding of snake-root.

No. 9. Female rabbit weight 33 ounces, taken from her home, Dec. 23. Temperature in next three days taken only five times, ranged from 99.8° to 101.9°. At 3:30 P. M., Dec. 26, I gave her in milk about  $\frac{1}{4}$  ounce of extract from same bottle as that used for the injection of No. 8. It had already been twice boiled for a long time. I gave her some of this with milk or cabbage or lettuce on each of the three succeeding days, about one ounce altogether. Dec. 27, 7:30 A. M., temperature 102.2°; 11:35 A. M., temp., 103.5°; 2:10 P. M., temp., 103.8°; 4:30 P. M., temp., 103.5°.

From Dec. 27 to Jan. 14 her temperature was taken several times each day, ninety times altogether. Only twice was it found below 102.2°, the maximum being 105.3°. No other effect of poison manifest until Dec. 28 when I noticed a tremulous motion of her sides, and rapid and irregular breathing. The motion of the sides seemed a sort of panting, the rate in the afternoon about 96 per minute. The next day the panting was not noticeable and never became very distinct again, except when there was external cause for excitement. Jan. 4, 11:40 A. M., I began giving each day some milk in which snake-root leaves had soaked. Jan. 6, 9:30 P. M., she showed a sort of trembling the motion being backward and forward. This has been noticed infrequently since, also a little panting and lessening of strength. Otherwise she has seemed well. She has been well fed all the time. No change of temperature can be attributed to withholding the poison after Dec. 29 or giving it again in different form Jan. 4-7 and 11-12. No constipation.

No. 10. A female rabbit, weight 11 ounces. Jan. 11, began giving her milk in which snake-root had soaked, one third as much each time as to No. 9, her weight being one-third as great. She has shown similar effects. Her temperature changes help to understand those of No. 9. Before removing her from the warren her temperature at 3:30 P. M. was 102.9°, about like that of others of her size but lower than in the larger rabbits. She was carried a mile in the sleeve of a laboratory apron most of the way on a warm car. In twenty minutes her temperature had fallen to 99 and at 9:30 P. M. to 98.4°. It was higher every

afternoon but did not rise as the days went on and, although well fed and allowed to stay part of the time with rabbit No. 9, nothing availed to bring her temperature up to 102°, until she was given milk in which snake-root had soaked. This was on the evening of Jan. 11 and the following days. Jan. 12 her temperature reached 101.8°; Jan. 13, 102.6°; Jan. 14, 104.3°.

Further experiments with rabbits have shown that, like cats, they may acquire some degree of tolerance of the poison, also that one ounce gathered in January is not sufficient to kill a large rabbit. One weighing 3½ pounds ate 28 grams of snake-root January 21-27, with a little good food. Twitching was noticed January 27-30, during which time she was well fed. Then she ate nine grams more of snake-root but survived. Another weighing nearly four pounds was made to tremble or twitch by injections of a decoction of snake-root January 21, 22 and 30, and by eating of the leaves and branches 67 grams, February 1-5, but survived.

#### *Sheep.*

No. 11. Saturday morning, Jan. 6, 1906, I went into the country and selected from a flock a healthy female lamb of about forty pounds weight and brought it home on the electric cars. In the afternoon I gathered in the woods 88 ounces of white snake-root of which I gave her 8 ounces at 4:45, on the next day 34 ounces and the remainder Monday and Tuesday morning. She took it more readily than I had expected, in fact, after being without other food not very long she ate the snake-root leaves quite greedily, but the coarse stems would not eat at all, even when cut into rather small pieces and soaked over night in water. The total amount consumed was about 29 ounces. Other food was withheld only until Monday when at 5 P. M. I gave her about a pint of bran all of which she ate. Water was offered several times every day but only a few ounces taken altogether.

Until Tuesday evening I saw nothing wrong with her whatever though Tuesday noon I noticed that she had not cleaned out the box containing the snake-root leaves quite so well as before. If she had been watched long at this time quite likely some effect of the poison would have been noticed. I did not see her again till after dark. Then having weighed out some freshly gathered snake-root to give her I noticed that she stood facing away or to the side instead of manifesting eagerness for it as heretofore. Then I noticed deep and unnatural breathing, an almost spasmodic movement of the sides. After taking a few steps, she lay down as if unable to stand. When pushed she arose, walked a few steps and sank down again. I went for H. H. Lockwood who had seen sheep affected by trembles and

H. A. Winters who had lost many sheep and other animals from trembles. On returning I saw a little trembling of the flesh at the hips. After watching her awhile they both felt sure that she had the trembles and in conversation with me the next day Mr. Winters said the symptoms were unmistakable. She ate some bran while lying down, stopping to let her head rest on the corner of the box. She raised her hind quarters but failed in attempting to straighten her front legs and so ate while kneeling. At 10 P. M. she was lying still, her respirations rather deep and about 16 per minute. She gave no heed to the lantern.

The next morning she was unable to rise or even to stand when lifted onto her feet. Nor would she eat. Breathing spasmodic but no trembling. At noon she was still lying in the same place, her breathing deeper and about 25 per minute. Without any urging she struggled as if to rise and this doubtless increased the respirations somewhat. Whether she had done this at frequent intervals I could not tell. No trembling but the breathing quite laborious and unnatural. At 3:40 P. M. still in same position. Respirations labored, irregular, 33 per minute after a fit of kicking, then after a short interval 30 per minute. About 4:20 there was violent struggling involving not only the legs but the abdominal and other body muscles. At 4:40 I found her dead. Post mortem examination the next morning showed that the kidneys were enlarged to double the normal size. One of them weighed 50.3 grams, one obtained from a lamb of about the same size at a market and another from a lamb about half again as heavy weighing 25.5 and 26 grams.

No other organs were found enlarged, inflamed or congested or in any way unnatural in appearance with the possible exception of the brain which some thought slightly congested. The abdominal cavity contained several ounces of liquid, "due to feeble circulation preceding death." Besides H. C. Schoepfle, M. D., and Dr. Hinkley, a veterinary physician, I had three butchers, one at a time, examine the body. There had been no constipation. The rumen was well filled with snake-root. Death would likely have come almost as soon had she eaten none of it after Sunday. The quantity given Saturday afternoon and Sunday was 42 ounces, of which 14 may have been eaten. Likely enough a small fraction of this would have sufficed to produce trembles, though death might not have come so quickly—four days from the time of first feeding.

Meat from this sheep was fed to four animals. A large cat ate six ounces of the liver about 5 P. M. and the next morning trembled violently, less as the day went on and, after that, none. A cat of the same size ate six ounces of muscle from a hind leg, but showed no effect for two days or so when it became sick, losing its appetite but not trembling. It has recovered. A

rather small cat took four ounces of liver and running off with it was not seen again for three days when she seemed quite sick but could not be caught. A dog (No. 5) ate four ounces of liver showing no effect for two days when he became dull. The fourth day, having apparently recovered, he was given the heart and spleen. After about 24 hours fits of trembling affected his limbs, some of it still noticeable the next day, after which he was all right.

All our experiments were with weeds gathered after many hard frosts and nearly all with weeds gathered from woods that have long been pastured without a single case of trembles, so far as the owners know, ever having occurred in them. In gathering it I did not notice a single plant that had been nipped off. The absence of inflammation in the animals that we experimented on as well as in those that contract the trembles in the pasture shows that the poison is not an irritant. The quickness of its action and the fact that trembling is a characteristic effect indicate that it acts on the nervous system.

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